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Using biogeochemical tracing and ecohydrological monitoring to increase understanding of water, sediment and carbon dynamics across dryland vegetation transitions

Alan Puttock (1), Jennifer Dungait (2), Kit Macleod (3), Roland Bol (4), and Richard Brazier (1)

(1) University of Exeter, CLES, Geography, Exeter, UK (ap267@ex.ac.uk), (2) Sustainable Soils and Grassland Systems Department Rothamsted Research-North Wyke Okehampton Devon, UK, (3) The James Hutton Institute Craigiebuckler, Aberdeen, AB15 8QH, Scotland, UK, (4) Forschungszentrum Juelich GmbH 52425 Juelich Sitz der Gesellschaft: Juelich, Germany

Drylands worldwide have experienced rapid and extensive environmental change, which across large areas has been characterised by the encroachment of woody vegetation into grasslands. Woody encroachment leads to changes in the abiotic and biotic structure and function of dryland ecosystems and has been shown to result in accelerated soil erosion and loss of soil nutrients.

The relationship between environmental change, soil erosion and the carbon cycle in dryland environments remains uncertain. Covering over 40 % of the terrestrial land surface, dryland environments are of significant global importance, both as a habitat and a soil carbon store. Thus, there is a clear need to further our understanding of dryland vegetation change and impacts on carbon dynamics. Here, grama grass to creosote shrub and grama grass to piñon-juniper woodland; two grass-to-woody ecotones that occur across large swathes of the semi-arid Southwestern United States are investigated.

This study combines an ecohydrological monitoring framework with a multi-proxy biogeochemical approach using stable carbon isotope and n-alkane lipid biomarkers to trace the source of organic carbon. Results will be presented showing that following woody encroachment into grasslands, there is a transition to a more heterogeneous ecosystem structure and an increased hydrological connectivity. Consequentially, not only do drylands lose significantly more soil and organic carbon via accentuated fluvial erosion, but this includes significant amounts of legacy organic carbon which would previously have been stable under the previous grass cover. Results suggest that dryland soils may therefore, not act as a stable organic carbon pool and that accelerated fluvial erosion of carbon, driven by vegetation change, has important implications for the global carbon cycle.